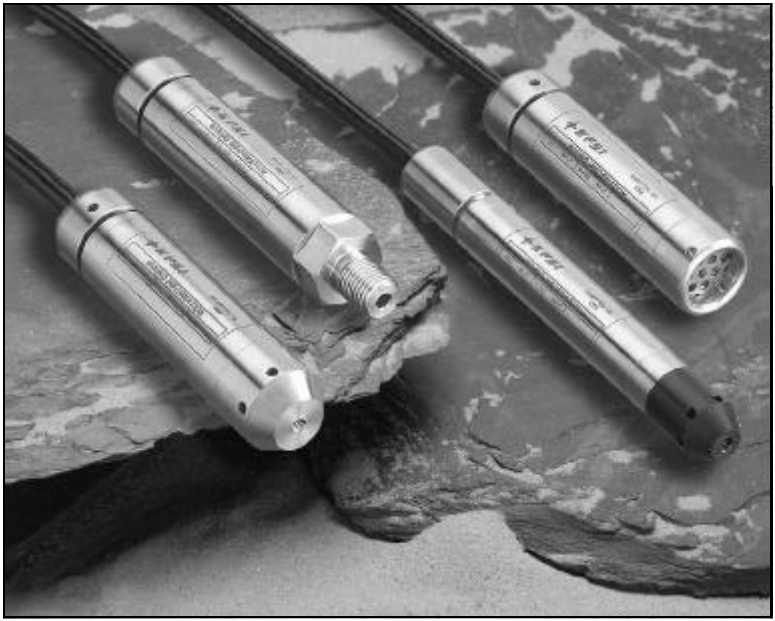
User's Manual

5th Edition

March 1, 2000



Example DOM: (The DOM is located on each transducer/transmitter housing)
DOM: 9914 99 is the last two digits of the year of manufacture (1999)
14 is the week of manufacture (14th week of 52 week year)

- When returning units to the Repair Department, please include the vent filter or aneroid bellows.

- **Vent filters should be changed when they are 75% spent (pink).** Do not remove the old vent filter until a new one is available. The number one failure mode is moisture and corrosion damage due to lack of maintenance of the vent filter.

- There is a 90 day warranty on all repairs.

Intrinsic Safety

Most of our products are available with FM, UL and CSA certification for intrinsic safety as well as CE approval for EMC.

2.0 Product Description and Use

General Characteristics

Our submersible pressure transducers use isolated diaphragm sensors that are specifically designed for use with hostile fluids and gases. These sensors utilize a silicon pressure cell that has been fitted into a stainless steel package with an integral, compliant stainless steel barrier diaphragm. This sensor assembly is housed in a rugged 316 stainless steel case which provides for a variety of pressure inputs from 0-1 through 0-300 PSI. Our devices feature internal signal conditioning. Standard outputs are 4 to 20 mA , 0 to 100 mV and 0 to 5 VDC. Other outputs are available upon request.

All units have surge and reverse polarity protection. For ease of use in the field, our transducers are permanently etched with our logo and name, wiring information, part number (P/N), serial number (S/N), date of manufacture (DOM), range, excitation and output. Pressure transducers are offered in diameters of 1.0 and .74 inches.

Care and Handling

Our submersible transducers are designed for rugged use. But they need protection from overpressure and sharp impact. When lowering them into a liquid, penetrate the surface slowly and only to the depth necessary. Avoid dropping the unit from above the surface. Clean transducers by rinsing them in a mild detergent. Direct probing of the diaphragm or attempts to remove protective screens will damage the sensor, voiding the warranty.

Calibration

All pressure transducers are shipped with calibration information unique to each transducer. Make sure you keep each calibration report. However, should you misplace your calibration sheet, you can contact the factory to have a duplicate faxed or mailed to you.

3.0 Product Accessories and Options

Nose Caps

There are several different user-installable nose caps for the Series 700, 710, 720, 730 submersible pressure transducers. The closed-faced ported cap (316 SS or Delrin) with #8-32UNC-2B threaded hole is best used where weights are required and for those installations where users may encounter sharp, protruding objects. The open-faced cap which allows maximum contact with the liquid media is ideal for wastewater and "greasy" applications where clogging of the sensor is a concern. The 1/4" male NPT pressure cap is not only useful for calibration purposes but also allows the device to be used as a submersible or above ground pressure transducer. The piezometer cap allows the unit to be buried in saturated soil without damage to the sensor diaphragm.

Series 810 Vent Filter or Series 815 Bellows

We supply with each submersible pressure transducer, a protective barrier against moisture collecting in the cable vent tube. This ensures reliable operation and long life as it protects sensitive electronic components from mildew, corrosion, rust and prevents the formation of a liquid column in the vent tube. Any such column directly affects calibration.

Series 820 Sacrificial Anode

The Series 820 Sacrificial Anode provides cathodic protection against galvanic corrosion for our submersible pressure transducers. Galvanic corrosion occurs when dissimilar metals are placed in contact with an electrolyte. This condition causes a potential difference to exist between the two metals, causing electron flow between them. Corrosion of the less corrosion-resistant metal is increased and attack of the more resistant metal is decreased. The Series 820 Sacrificial Anode is clamped to the exterior of the transducer. We also offer a 1" diameter version that attaches to the nose cap of the transducer.

Our sacrificial anodes are made from a special zinc alloy formulated to guarantee continued effectiveness over long periods. Because the anodes are 95% galvanic, they will not corrode unless there is an electrolytic demand. The anode maintains a high driving potential throughout its 12 month life, is self-sluffing and always exposes new zinc for the best possible protection. For those applications where cable buoyancy is a problem, the nominal 21 ounce sacrificial anode can be substituted for hanging weights.

Polyurethane & Tefzel® Jacketed Cable

Most installations of our submersible pressure transducers connect our polyurethane or Tefzel® cable to a junction box. From this junction box, users run their own cable to the required instrumentation. Polyurethane is used for most applications while Tefzel® is recommended for highly corrosive environments.

Specifications for our standard polyurethane and Tefzel® jacketed cable are as follows:

Specifications	Standard Submersible Cable
Weight	0.05 lbs/ft
Min. OD	0.28"
Max OD	0.31"
Conductors	4 - 22 AWG
Insulation **Conductors** **Outerjacket**	 PVC Polyurethane or Tefzel®
Shield	36 gauge spiral tinned copper wire
Vent Tube	polyethylene, .060" ID

Chemical Resistance of Polyurethane: Potable Water, Waste Water, Borax, Butane, Animal Fat, Carbonic Acid, Citric Acid, Cod Liver Oil, Corn Oil, Glycerin, Glycol, Mineral Oils, Potassium Nitrate, Potassium Sulfate, Silicone Oils, Stoddard Solvent, Tannic Acid (10), Tartaric Acid, Turbine Oil.

Chemical Resistance of Tefzel®: Acetic Acid (Glacial), Acetic Anhydride, Acetone, Aluminum Chloride, Anti-Freeze, Bromine, Calcium Chloride, Calcium Hydroxide, Chlorine, Copper Chloride, Ferrous Chloride, Hydrochloric Acid, Ketones, Lacquer Thinners, Sulfuric Acid.

The vented cable termination end is specially prepared at the factory to eliminate future moisture migration down its length. It can be noticed where the lead wires emerge from under the jacket that a potting material plus shrink tube “boot” have been added. Every effort should be made to leave this feature intact. Should the cable be longer than is needed for the particular installation, it is recommended that the excess length be accommodated in a service loop and that the potted end of the cable NOT be shortened.

The cable attached to this instrument is specifically engineered for submersible applications. The polyurethane outer jacket provides long term reliability under most conditions. The cable should be handled carefully, however, as the jacket may be subject to cutting should it be “raked” over extremely sharp edges. To guard against water incursion should an inadvertent cut occur, we have incorporated an exclusive “water block” feature immediately beneath the jacket. This feature makes the cable “self-sealing” in all but the most extreme cases. The cable is fully shielded, with the shield connected to the metal housing at the transducer end and terminated in a blue-insulated wire at the termination end. The shield should always be terminated to a good earth ground, unless the transducer is installed in an area where electrolytic corrosion is known to be a serious problem.

Lightning Protection

We can provide optional lightning and surge protection for the 0-5 VDC and 4-20 mA output of our 1 inch diameter units. This is achieved through the use of 2 protectors. One is housed in a 4 inch long, 1 inch OD 316 SS tubing attached directly to the non-pressure sensing end of the transducer while the other is the located at the surface and grounded to a DIN-3.

Featuring quick response and low clamping voltages, these devices protect against fast rising voltage transients as well as severe current surges associated with lightning discharges in excess of 10,000 amperes. Following a surge, the protector automatically restores the line to normal operation and awaits the next surge without having to reset a breaker or replace a fuse.

½" Male NPT Conduit Fitting

Submersible pressure transducers can be attached to a rigid conduit and the cable run through the conduit. To achieve this, all of our submersible transducers can be fitted with an optional ½" NPT male conduit fitting where the cable exits the transducer. This fitting can then be mated to a standard rigid conduit.

Variety of Electrical Outputs

Most applications call for a 0-5 VDC, 4-20 mA or a 0-100 mV output. But where necessary, our transducers offer a broad choice of possibilities including, among others, 0-10 VDC, 0-2.5 VDC, or ratiometric mV/V.

Temperature Output

A 4-20 mA output for temperature (OPTION-023) is also available for most transducers having a 4-20 mA pressure output. The temperature sensor requires an excitation of 9-30 VDC and is calibrated for a temperature range of 0-50ºC. Wiring information: White = + Excitation, Green = Signal out. Please see Appendix B.

Cable Hanger

We can supply an optional cable hanger to help end users secure the cable. The cable hanger can be positioned anywhere on the cable by pushing the ends together. Once positioned, the cable hanger expands and provides a snug grip on the cable.

When mounting the transducer in a well casing, the cable hanger can be secured to a hook on the well plate or an eyebolt may be attached to the side of the well casing. The cable hanger loop is then secured to the eyebolt by using any number of types of fasteners. A similar technique can be used when working in still wells for surface water level measurement. In this case, the loop-end of the cable hanger can be attached directly to a screw or bolt bored into the still well shelf.

Cable Splicing Kit

Our field-installable cable splice allows you to splice our polyurethane and Tefzel® cable. It is most commonly used for well applications where the more expensive Tefzel® cable is required for suspension in corrosive media where the liquid level is fairly shallow but the well is hundreds of feet in depth. It also is used in those emergency situations where cable must be spliced together to get an application up and running.

4.0 Installation & Maintenance Tips

General Installation Procedures - Submersible Units

Most installations either suspend our submersible transducer in a perforated 1 ½" or 2" PVC instrumentation stilling well or attach the transducer (using our optional conduit fitting) to a rigid conduit. It is not advisable to tie the transducer to the pump or piping, as a problem with the transducer would then require that the pump be pulled (very expensive).

A minority of applications use our optional bracket to clamp the transducer to a fixed object (i.e., wall, ladder, step) or require the unit to be suspended without any protective still well or attachment device. In all installations, care should be taken to ensure no damage occurs to the cable as cable damage represents one of the most frequent causes of transducer failure.

Cable Lengths

The maximum length of cable to be used with our submersible pressure transducers is largely dependent upon the type of electrical output of the pressure transducer. For a 0-5 VDC output, a maximum cable length of 100 feet is recommended as a voltage output is more susceptible to electrical interference than a 4-20 mA signal.

A 4-20 mA signal can be transmitted much longer distances depending upon such factors as temperature, wire size, length of wire, power supply and voltage requirements of any devices to be powered. At 25ºC the 22 AWG conducting copper wire used in our polyurethane jacketed cable has a resistance of 16.45 ohms per 1000 feet.

Using Ohms Law (E=IR) where E=voltage, I=current and R =resistance, one finds that a 20 mA signal requires .329 volts to drive it along 1000 feet of 22 AWG copper wire (E=16.45 x .020).

To find out how much voltage is required to drive our Series 700 submersible pressure transducer's 4-20 mA signal 10,000 feet, just add the minimum power requirement of the 700 (9 VDC) to the resistance offered by 10,000 feet of our polyurethane jacketed cable (10,000÷1000 x .329=3.29). The resulting power requirement is 12.29 VDC (9 + 3.29).

Reverse Signal

For some applications, it is important to know how far the water is from the top of the tank or the surface of the ground. If specified by the customer, our factory can set the transducer so that zero pressure reads full scale electrical output and maximum pressure reads zero output.

Drying Transducers

If you happen to get water in the vent tube and in the submersible pressure transducer, coil the cable and transducer in a pan and place the pan in an oven at 50ºC for 2 hours. This on-site remedy may do the trick. Be careful that the oven temperature does not exceed 50ºC. Otherwise, you may damage the transducer and cable.

4-20 mA Wiring

To connect a 2 wire 4-20 mA transducer to a typical power supply and mA meter, connect the + (red) lead of the transducer to the + terminal of the power supply. Connect the - (black) lead of the transducer to the + input terminal of the meter. Connect the - input terminal of the meter to the - terminal of the power supply with a length of 22-24 AWG wire.

VDC Wiring

To connect a 3 wire VDC output transducer to a typical power supply and the voltmeter, connect the - terminal of the power supply to the - input terminal of the meter with a length of 22-24 AWG wire. Connect the - excitation (black) lead of the transducer to the - input terminal of the meter. Connect the + input terminal of the meter to the signal lead (white) of the transducer. Connect the + terminal of the power supply to the + lead (red) of the transducer.

Cable Protection

An inexpensive way to protect the cable from damage is to order the submersible pressure transducer with a ½" conduit attachment. Connect an inexpensive flexible 5/8" garden hose to the ½" conduit fitting with an equally inexpensive female PVC ½" NPT x 3/4" NHT swivel fitting, available at your local hardware store.

Bending of Cable

Our polyurethane and Tefzel® jacketed cables are quite flexible. Care needs to be taken to ensure that when bending the cable to suit your installation you do not crimp the vent tube inside the cable. Consequently, do not bend the cable more than a radius of 1 inch.

Cable Compression

Many users require a compression fitting to secure our Tefzel® and polyurethane jacketed cable as it enters a junction box. Care needs to be taken that you do not overtighten the fitting so as to damage the cable.

Appendix A

Frequently Asked Questions

1. I need proof pressure much greater than 1.5 X. How can you help me?

   We can provide 5 X over pressure protection on most ranges if you can accept a thermal error of 0.1% full scale output per degree Centigrade.

2. What installation ideas do you have to help me get rid of electrical noise interfering with the signal?

   An ounce of prevention goes a long way. Either try to eliminate the source of noise or move the transducer as far away from it as possible. We strongly encourage you to secure our cable shield to a good earth ground and that you use a 4-20 mA signal output. Armed with these precautions and the fact that many of our transducers are CE approved for electromagnetic interference, you should have few problems.

3. My cable on the submersible always seems to get cut and damaged. What am I doing wrong?

   This is the most common problem that our users encounter. Make sure that all of your colleagues and staff understand the importance of handling the cable with care. The cable should not be bent around rough or sharp edges. Always use a cable reel during transport. Where possible, suspend the unit in a perforated 2" PVC pipe and thread the cable through protective conduit to the nearest junction box. This is a problem that KPSI directly addresses with the water block feature in our cable.

4. I have an application where the transducer is frequently damaged by voltage spikes. What can be done to prevent this?

   At a minimum, make sure the cable shield is connected to an earth ground as near as possible to the transducer. We can provide a surge protection kit for both our below and above ground transducers and transmitters. These kits will handle typical spikes that might come in through the power lines as well as surges that travel through the ground due to nearby lightning strikes.

5. How much impact shock can your submersible transducers withstand?

   The lower pressure ranges can be damaged if dropped from several feet onto an unforgiving surface like concrete, so we recommend that the protective shipping foam remain in place until the unit is installed.

6. What is the response time of your transducer?

   From initial power up, the transducer output will stabilize within a fraction of a second. The frequency response is rather low, probably less than 1 kHz, but it really depends on the application, the media, plumbing, etc. Call our factory for application assistance if frequency response is critical in your application.

7. How do I attach your vent filter or aneroid bellows to my cable vent tube?

   The vent filter can be mounted anywhere convenient, preferably out of the weather. It can be mounted in any position and connects to the cable vent tube via the extension tube with metal connector tube provided. The aneroid bellows must be mounted in a way that its movement is not encumbered. It is provided with a mounting base that will install to a standard DIN3 mounting rail common to most control panels. Also provided with the bellow is a 3 inch length of DIN3 rail, just in case one is not already available.

8. What is the best way to mark my cable?

   Use white vinyl marking tape available from your local hardware or electronic stores. These same stores may also sell cable marking kits.

9. Any ideas for preventing marine growth on your submersible transducers?

   You might want to try waterproof grease. Remove the threaded nose cap to facilitate applying the grease. Take care when applying the grease not to trap air bubbles against the sensing diaphragm and not to damage the diaphragm.

10. How many pressure measurements can you make before the diaphragm on the pressure sensor fails?

    In normal operation - millions of cycles. We find that transducer failure is rarely due to diaphragm fatigue.

11. What is the mean time between failure for your submersible pressure transducer?

    Most failures are due to misuse by the end user. However, properly installed units last tens of thousands of hours.

12. What can be repaired on your pressure transducers?

Cost of repairs varies depending on the problem. As a rule of thumb, very badly damaged units can be repaired for about 50% of list price.

13. What is the turnaround time on repairs?

Once we receive a unit into our facility it takes approximately 5 working days.

14. What is the longest length of cable you have attached to a submersible transducer?

Two thousand feet.

15. Why do you use 316 SS housings and sensors for your standard transducers?

It offers a good combination of corrosion resistance and reasonable cost. As an option, we do offer other metals such as Titanium and Hastelloy for very corrosive environments.

16. What wire gauge should I limit myself to when connecting to your 22 AWG wire?

Use 22 AWG or greater.

17. Does it make any difference if I mount the transducer in a vertical or horizontal position?

No. Our units have a minimum amount of position sensitivity. You should mount it in the same position, however, throughout the measurement cycle.

18. What is the longest length of time one of your products has run continuously?

Since 1986, the year we first started manufacturing all-media pressure transducers.

19. What happens when you freeze your transducer in a column of water?

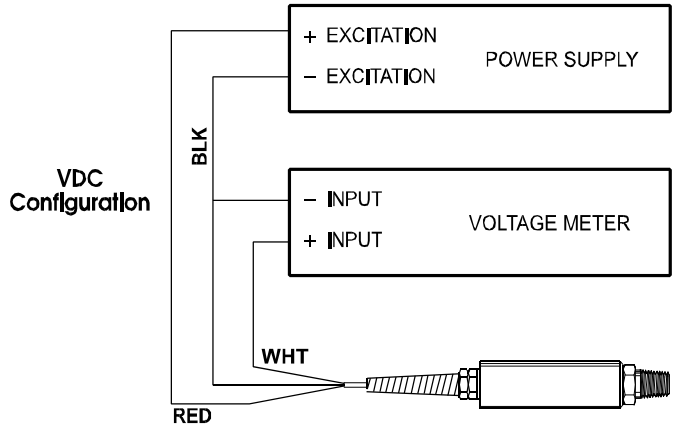
We have frozen our submersibles in a container of water in a home freezer, with no resulting damage. However, depending on the pressure range of the unit, over pressure of the unit is possible. In harsh environments where debris is common and ice shifts, you might expect damage to both the transducer and cable.

20. What are the most common reasons customers keep buying your products?

No hassle service.
Reliable, long lasting products.
We offer guaranteed lightning protection.
Use 800 numbers for order entry and support.
Excellent pre and post sales application support.
Quick response to problems.
Rapid delivery.

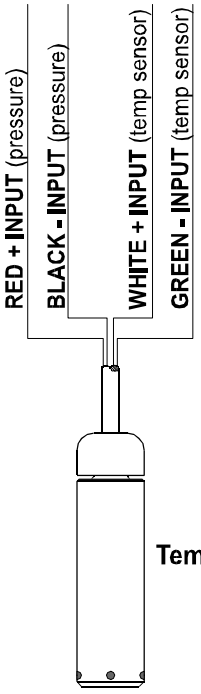
Appendix B

Wiring Diagram VDC, mA, mV and Temp Output B-2
Cable Anchoring Schemes B-3
Reference Connection Schemes B-3
Submersible Cable Termination B-4
Quick Check Procedure for Transducers/Transmitters B-5
Connection Diagrams for Option-009 and -012 . . . . . B-6

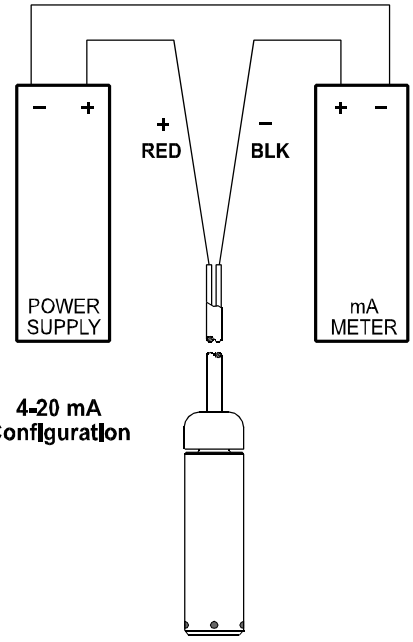


VDC Configuration

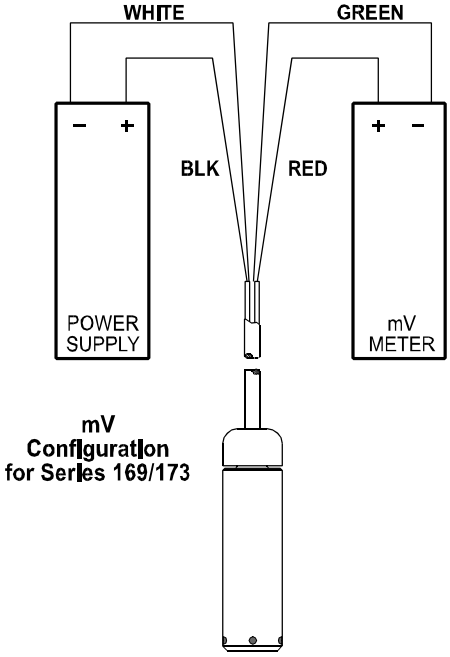
Note: These diagrams depict typical installations. Refer to your power supply and instrumentation manufacturer for the specifics of your application.



OPTION-023
Temperature output

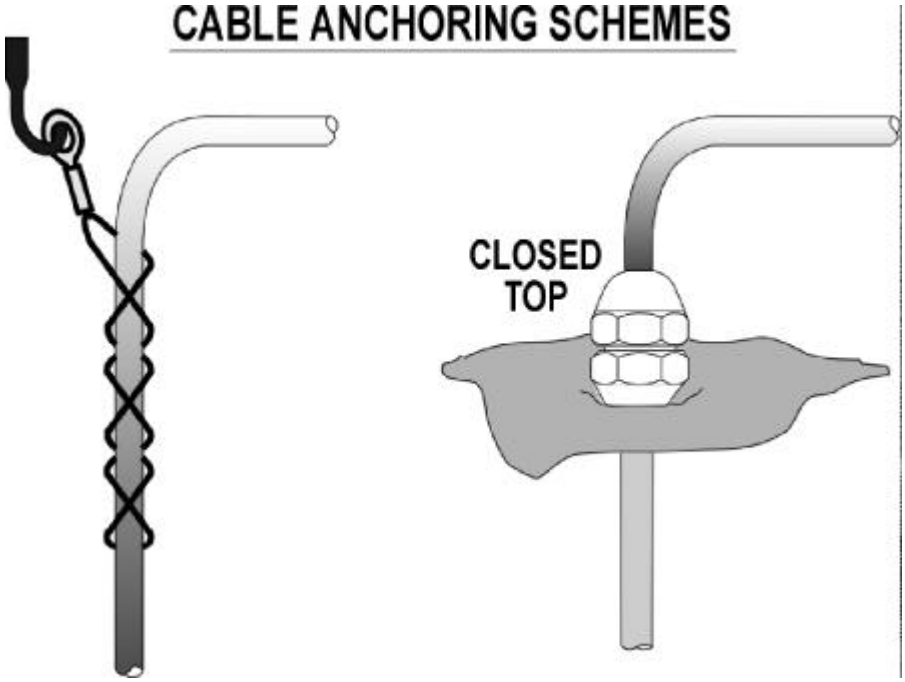


4-20 mA Configuration

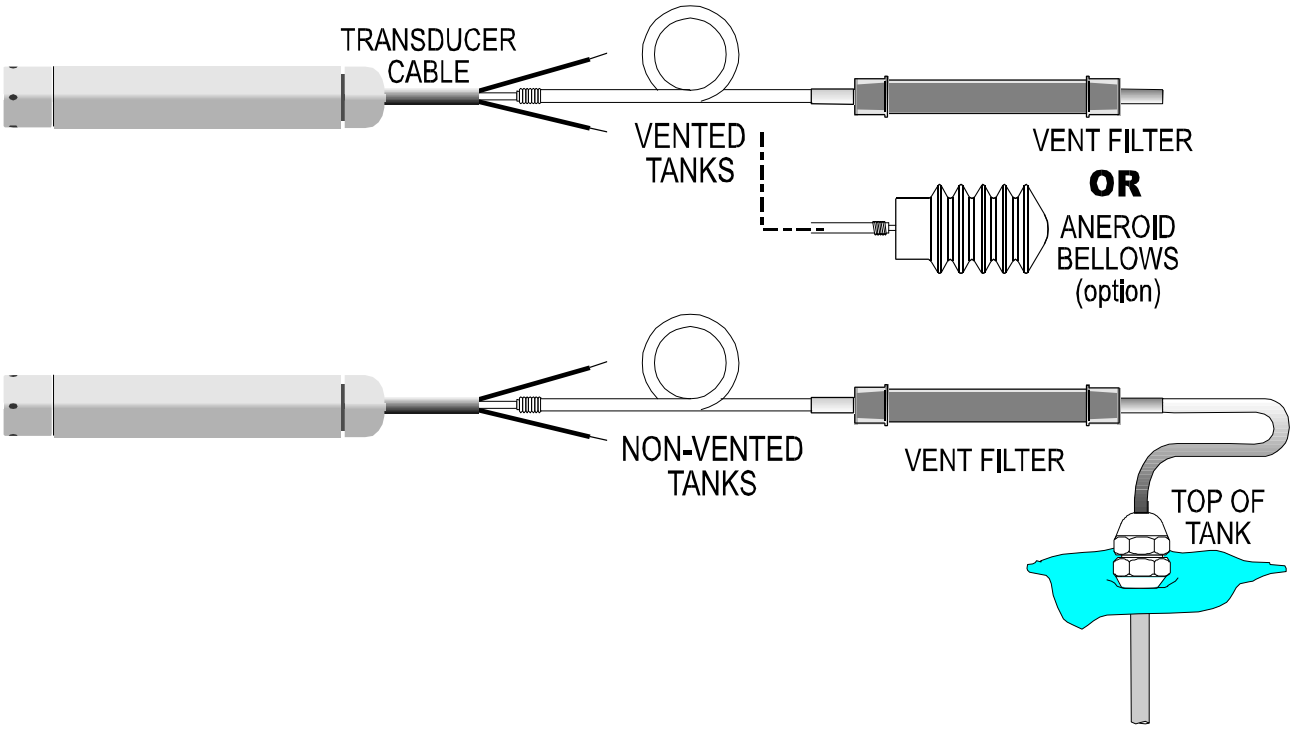


mV Configuration for Series 169/173

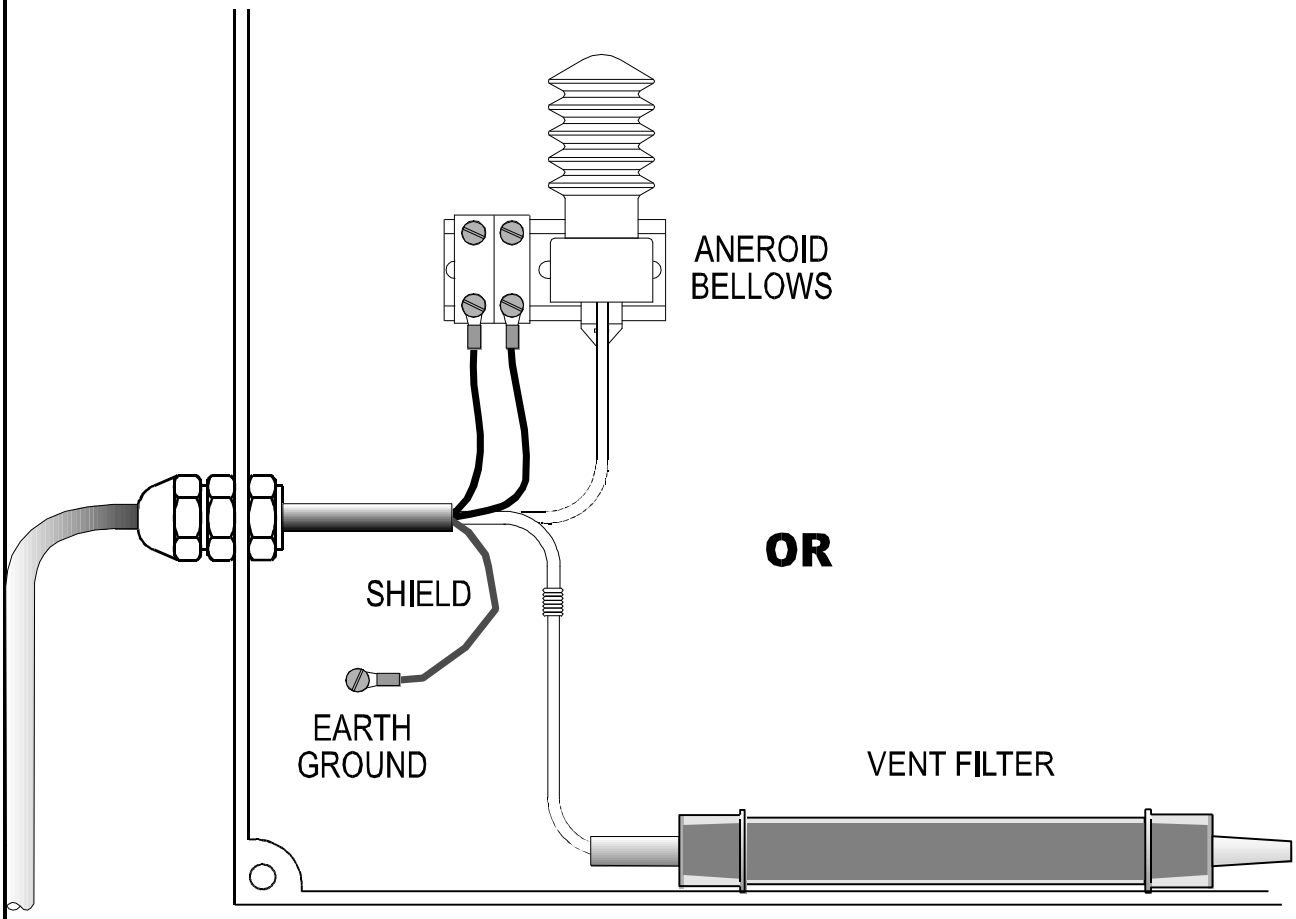
CABLE ANCHORING SCHEMES

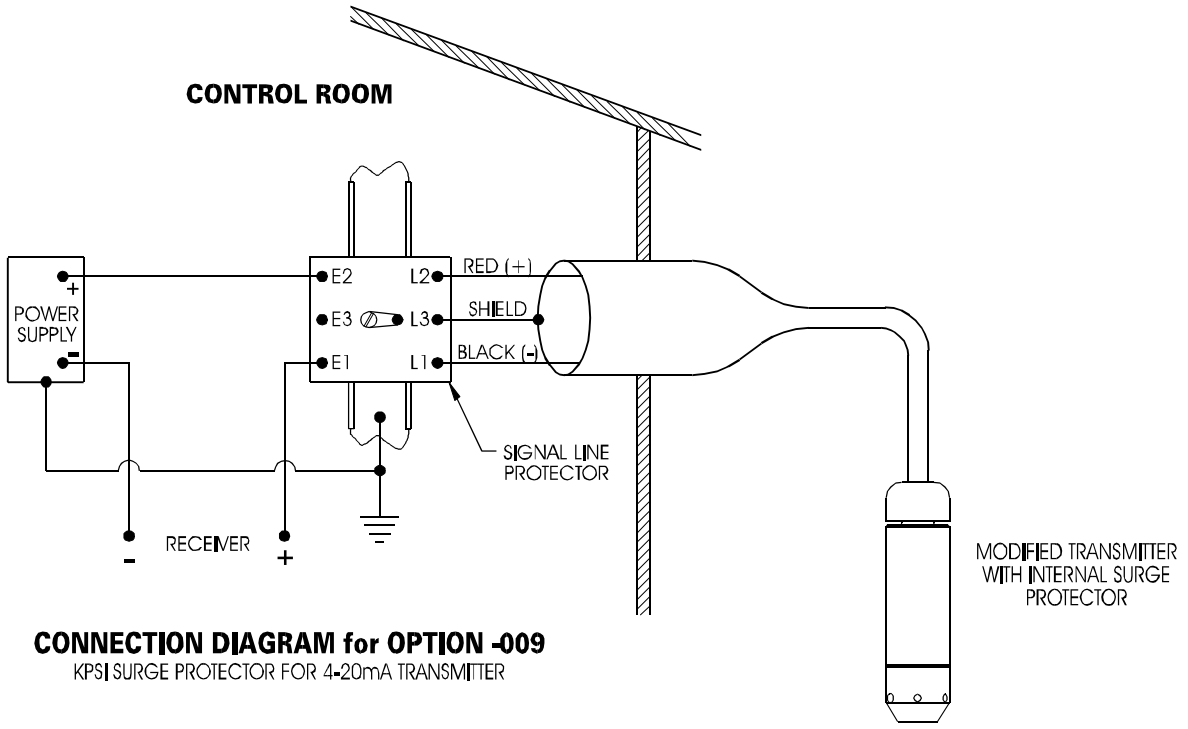


REFERENCE CONNECTION SCHEMES



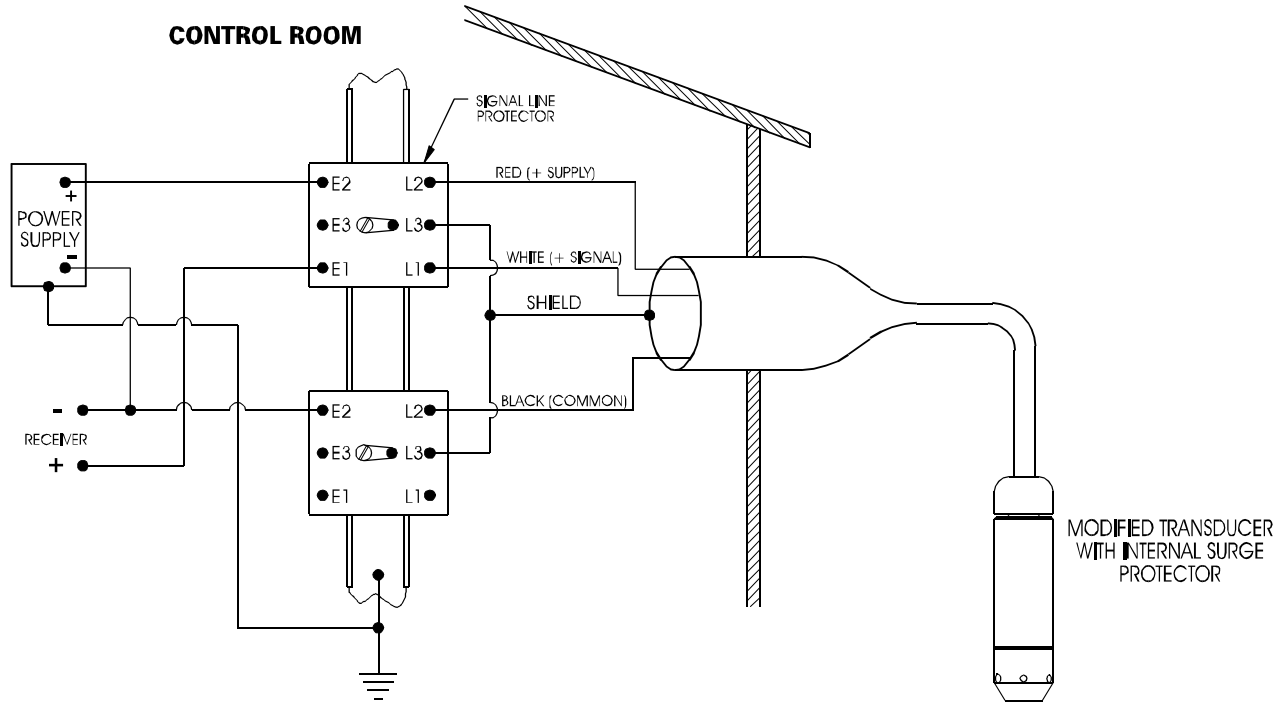
Submersible Cable Termination





CONNECTION DIAGRAM for OPTION -009

KPSI SURGE PROTECTOR FOR 4-20mA TRANSMITTER



CONNECTION DIAGRAM for OPTION -012

KPSI SURGE PROTECTOR FOR 0-5VDC TRANSDUCER

This page intentionally left blank.